SIEMENS

KNX

OpenAir^{TM}
VAV compact controller KNX/PL-Link G..B181.1E/KN

Technical Basics

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1 Introduction

1.1 Revision history

Version	Date	Changes	Section	Pages
2.5	25.10.2021	Update for Series H Removal of outdated parts		
2.0	23.03.2017	Update for Series G		
1.0	26.02.2016	EU and RCM Conformity, European Directive 2012/19/EU	8 Technical data, 10 Environmental compatibility and disposal	38 42

1.2 Before you start

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1.3 Objectives of this basic documentation

This basic documentation covers the networked VAV compact controllers GDB181.1E/KN and GLB181.1E/KN. These devices are designed for controlling variable or constant air volume flows.

This document is structured along the according workflow. Following a description of the devices and their application, mounting, engineering, and commissioning are covered. A references section lists technical data, parameters, and data points.

1.4 References

[1] G..B181.1E/KN – Datasheet for VAV compact controller (N3547)
[2] G..B181.1E/KN – Mounting instruction for VAV compact controller (M3547)
[3] AST20 – VAV handheld tool (A6V10631836)
[4] AST22 – Interface converter (A6V11236956)
[5] ACS931 – PC-Software for OEM (N5853)
[6] ACS941 – PC-Software for Service (N5854)
[7] ETS KNX Engineering Software – Download (https://www.knx.org)
[8] ACS790 – Synco Engineering Tool – Download (Login required) (https://support.industry.siemens.com/cs/document/109481853)
[9] Synco KNX S-Mode datapoints (Y3110)

2 Device

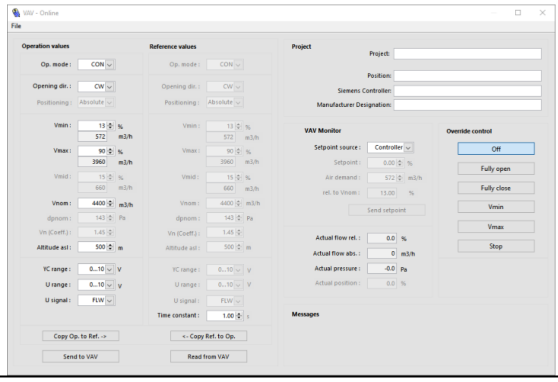
2.1 Type summary

2.1.1 Device variants, tools and accessories

VAV compact controller KNX/PL-Link

GDB181.1E/KN (5 Nm)	GLB181.1E/KN (10 Nm)
	

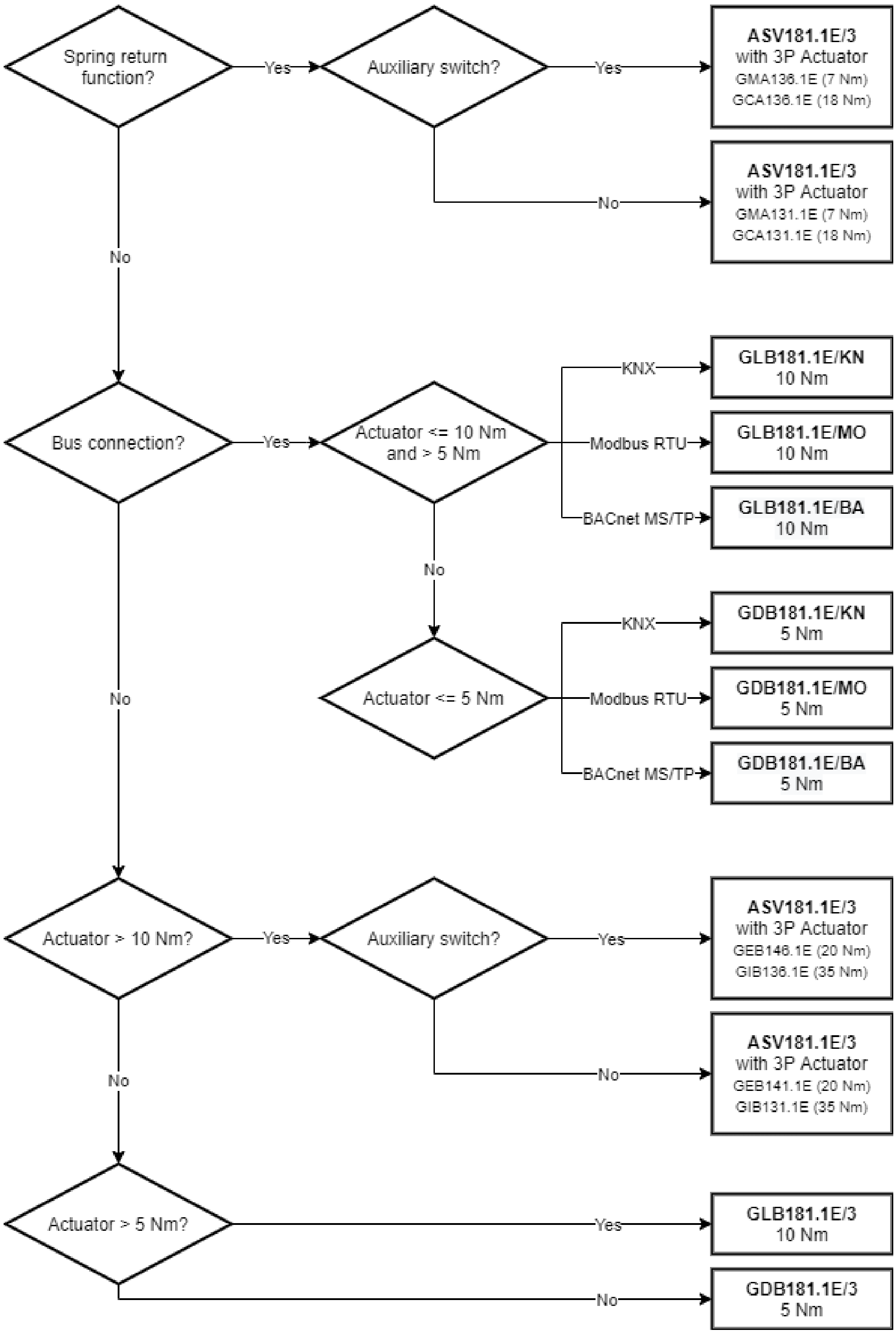
Tools for commissioning and service

AST20	ACS931 / ACS941
	
The handheld tool AST20 can be used for status monitoring, VAV parameter setting, and bus configuration setting. It supports a Service and an OEM access level with PIN code protection.	The PC software for service ACS941 can be used for setting and reading a certain set of device parameters (values set by OEM and current configuration, and actual values). The PC software for OEMs ACS931 can be used for full factory configuration in the and is distributed exclusively to VAV box OEMs. For connecting to a PC an interface converter AST22 is required.
Datasheet: A6V10631836	Datasheet ACS931: N5853 / Datasheet ACS941: N5854 Datasheet AST22: A6V11236956

Accessories

For information regarding accessories and spare parts for VAV compact controllers, please refer to datasheet N4698.

2.1.2 Selection guide for all types



2.1.3 Version summary

Each VAV Compact Controller has a product series identification which can be found in the top right corner of the product label. The product series gives information about significant hardware or firmware changes.

Version identification

Version	Series E	Series F and later
Identification		

VAV Compact Controllers series G and later are designed for using ETS device profile v2.x, however ETS device profile v1.x is supported for backward compatibility reasons.

Compatibility

Version	Series E	Series F	Series G	Series H
Production start	10/2011	03/2014	01/2017	01/2020
FW version	4.16	4.18	4.24	4.25
ETS profile v1.x	supported	supported	supported	supported
ETS profile v2.x	not supported	not supported	supported	supported
Major changes	- Desigo PL-Link or KNX (LTE- / S-mode) - New diff. pressure sensor - Feedback of actual damper position and air flow - Adaptive positioning. - HMI with push button and LED	- Stability Improvements Support for DMC (data matrix code) based workflows	- Improved ETS and Desigo ABT interfaces	- Improved PPS2 interface for programming efficiency

2.2 Design and device parts

The VAV compact controllers consist of a differential pressure sensor, actuator and digitally configurable control electronics. They are intended for mounting on damper shafts of a minimum length of 30 mm. They consist of base and 2-sectional housing.

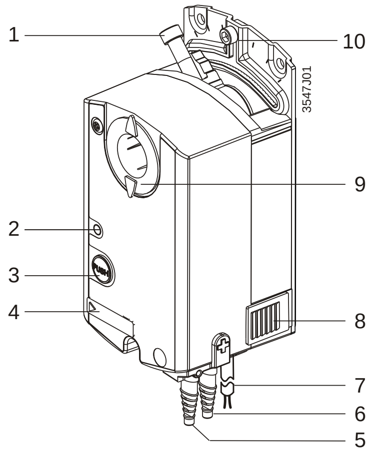
Components contained in the **base**:

- Steel base plate with damper drive shaft fixing for different drive shaft diameters / cross-sectional areas (cf. section **2.3**) and angular rotation limiter,
- maintenance-free, low-noise gear train,
- magnetic hysteresis clutch with practically contact-free force transmission; this means that the actuator is locking- and overload-proof, also in continuous operation.

Components contained in the **housing** (Note: the housing cover must not be removed):

- Controller electronics,
- differential pressure sensor,
- synchronous motor for the damper actuator.

Main device parts

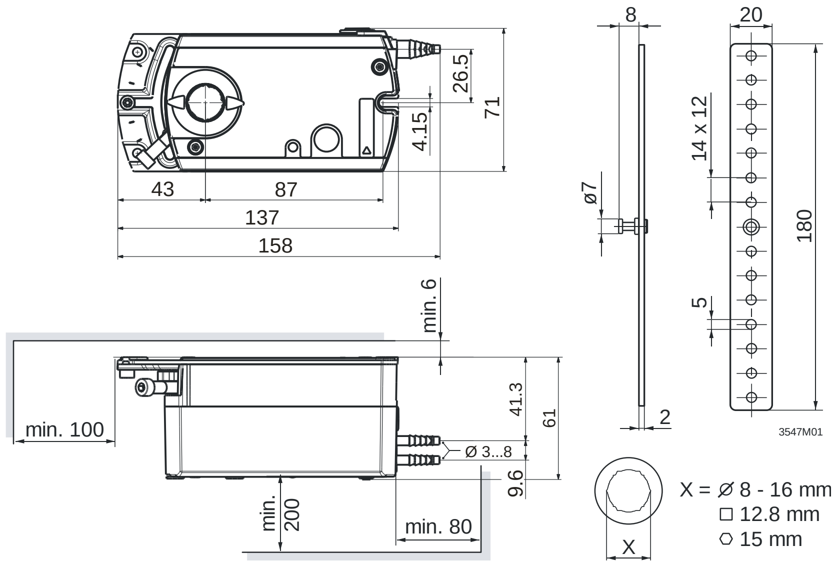


1 Shaft attachment screw
2 LED
3 Push button
4 Configuration and maintenance interface (below cover)
5 Connection nozzle for measuring differential pressure in the VAV box
6 Connection nozzle for measuring differential pressure in the VAV box ("+": Side with higher pressure)
7 Two connecting cables (power and communications), 2-core each
8 Disengagement of gear train
9 Rotation angle display
10 Rotation angle check screw

Gear train disengagement

Manual control of the air dampers is possible by gear train disengagement (8) when the VAV compact controller is **disconnected from the power supply**.

2.3 Dimensions



Measures in mm

2.4 Human-machine interface

User interaction with the VAV compact controllers' human-machine interface (HMI) (multicolor LED and push-button) is described below, cf. also section **6.3.1**.

Push button

Activity	Push-button operation	Confirmation
Enter / leave addressing mode	Press button < 1s	LED turns red or gets off
Reset to factory settings	Press button > 20s	LED flashes orange until device restarts
PL-Link connection test [1)]	Press key >2s and < 20s	LED flashes 1x orange

LED state display

Color	Pattern		Description
Off	---		Fault free operation or device not powered
Green	steady		Connection test successful [1)]
Orange	flashing	0.1 s on / 0.1 s off	Factory reset in progress
		0.25 s on / 1.75 s off	When a connection test was triggered: wait [1)]
Red	steady		Device is in programming/addressing mode
	flashing	0.5 s on / 2 s off	Internal error: Reset necessary
		1 s on / 1 s off	When a connection test was triggered: Connection test failed [1)]

[1)] Function or part of the function available in PL-Link operation only

Addressing and bus test with push button

The VAV compact controllers can be set into addressing/programming mode by push-button:

- Press push button (>0.1s and <1s)
- KNX bus wiring OK → LED turns red until addressing/programming is finished
- KNX bus wiring not OK → LED stays dark

Reset with push button

The VAV compact controllers can be reset by push-button:

- Press push button > 20s
- LED flashes orange
- Device restarts

All parameters which can be set by the OEM are reset to the OEM default values.

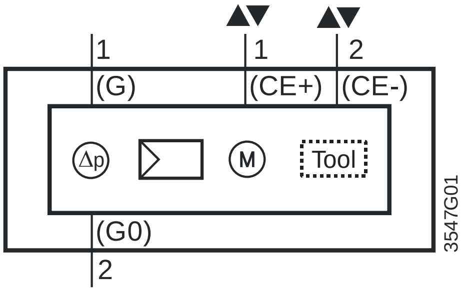
PPS2 interface

For OEM factory programming or commissioning / maintenance tasks directly at the VAV compact controller, a suitable tool (ACS931 / ACS941 with AST22, or AST20) can be connected to the PPS2 interface, cf. section **4.1.**

2.5 Internal diagrams

The VAV compact controllers are supplied with two prewired connecting and communication cables.

Internal diagram



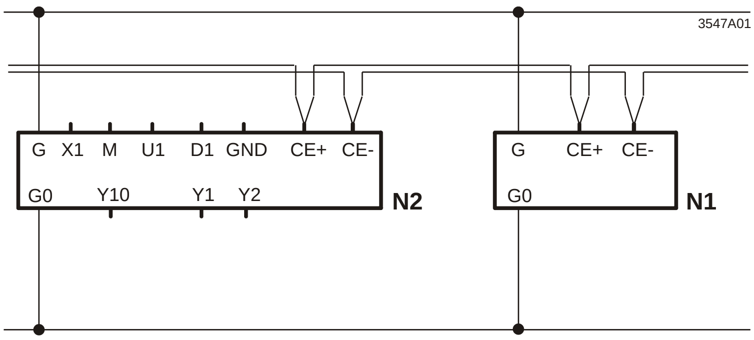
Tool = Configuration and maintenance interface (Series E and newer: 7-pin)

Power supply and bus cable (color coded and labeled)

Core designation	Core color	Terminal code	Description
Cable 1: Power / black sheathing			
1	red (RD)	G	System voltage AC 24 V
2	black (BK)	G0	System neutral AC 24 V
Cable 2: Bus / green sheathing			
1	red (RD)	CE+	Bus (KNX / PL-Link)
2	black (BK)	CE-	Bus (KNX / PL-Link)

The VAV compact controllers are connected to the bus as KNX devices according to the KNX-TP1 standard. KNX-specific limitations regarding cable length, power supply, number of attachable devices, and distances apply. For more details, please refer to [9] or to the KNX standard.

Wiring diagram VAV
Connection to the KNX TP1-Bus



N1 G..B181.1E/KN
N2 VAV enabled room unit

Note

Terminal layout may differ for each device. Devices with twin-terminals or internally connected terminals may be encountered as well as bus connection in junction boxes.

- The operating voltage at terminals G and G0 must comply with the requirements under SELV or PELV.
- Safety transformers with twofold insulation as per EN 61558 required; they must be designed to be on 100 % of the time.

2.6 Measuring principle

A measuring device for acquiring the differential pressure – usually a measuring cross, measuring orifice or Venturi tube in the airflow – represents the basis for air volume flow measurement.

Differential pressure sensor

The air volume flow is measured indirectly with a differential pressure sensor. Since the measured value is the differential pressure Δp, the air flow is derived from this value using the VAV box characteristic. Accordingly, the VAV box OEM has to provide the combination of Δpnom and Vnom, out of which the air volume flow in m^3/h or l/s can be calculated.

The air volume flow value (relative or absolute) can be transmitted over the bus together with the actual value of the damper position (in %) to be used by a supervisory controller or for management purposes. The differential pressure sensor operates long-term stable and without recalibration.

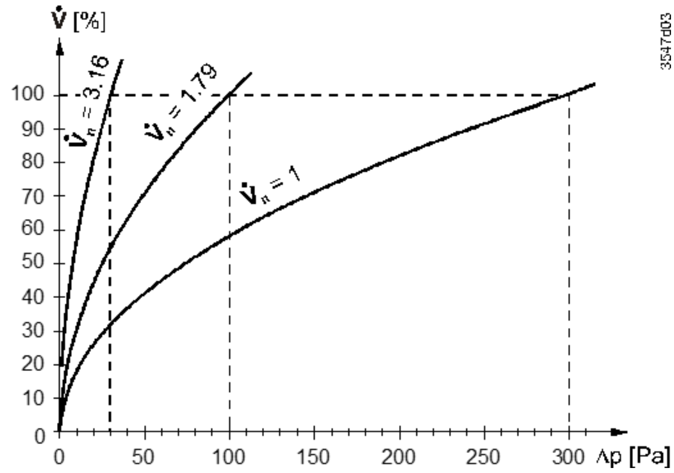
Note

In critical cases material compatibility tests should be made while considering harmful substances and concentrations.

Setting the characteristic value Vn

The parameter Vn is used to adjust the operating range of the differential pressure sensor (0…300 Pa) to the actual VAV box nominal pressure Δpnom at the factory. The effect of Vn is illustrated in the diagram below.

Effect of Vn



Calculation of Vn (Δpnom = nominal differential pressure)

$$V_n = \sqrt{\frac{300\ [Pa]}{\Delta p_{nom}[Pa]}}$$

Calculation example

Assume that a VAV box is designed for a nominal pressure of Δpnom = 120 Pa. Then Vn must be set to 1.58:

$$V_n = \sqrt{\frac{300\ Pa}{120\ Pa}} = 1.58$$

3 Functionality / application

3.1 Fields of application

Application

VAV compact controllers are primarily used for controlling a variable or constant air volume flow.

System environments:

- Building automation systems using the Siemens peripheral bus PL-Link (Desigo Room Automation)
- Synco 700 building automation systems using KNX LTE-mode
- Building automation systems using KNX S-mode

Application fields:

- Supply air control
- Extract air control
- Supply/extract cascade control with
  - Ratio control 1:1
  - Ratio control (positive/negative pressure)
  - Differential control (positive/negative pressure)
- Air dampers with a nominal torque of up to 5 or 10 Nm

Note

VAV compact controllers are not suitable for environments where the air is saturated with sticky or fatty particles or contain aggressive substances.

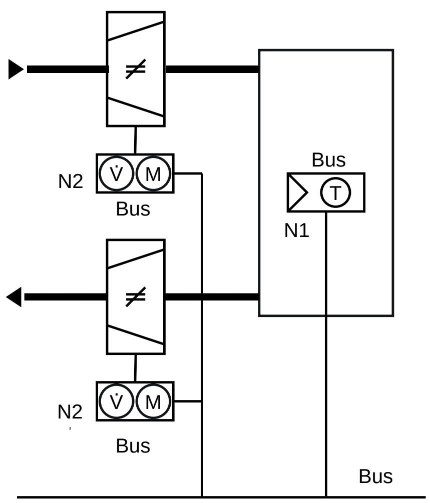
3.2 Application examples

VAV Compact Controllers can be used in supply air and in supply / extract air control applications. Demand-controlled ventilation (DCV) is possible when a communication link to the supply / extract air fans of the air-handling unit (AHU) is established and the AHU controller offers the required control algorithm.

3.2.1 Supply and extract air control

Supply / extract air control

If one VAV Compact Controller is used for supply air and one for extract air, these are usually controlled individually by the supervisory controller. By setting their volume flow limits (Vmin and Vmax) according to the setting instructions in section **5.3**, constant, positive, or negative pressure in a zone or a room can be achieved. When omitting the extract air part, a simple supply air control application can be realized.



Legend:

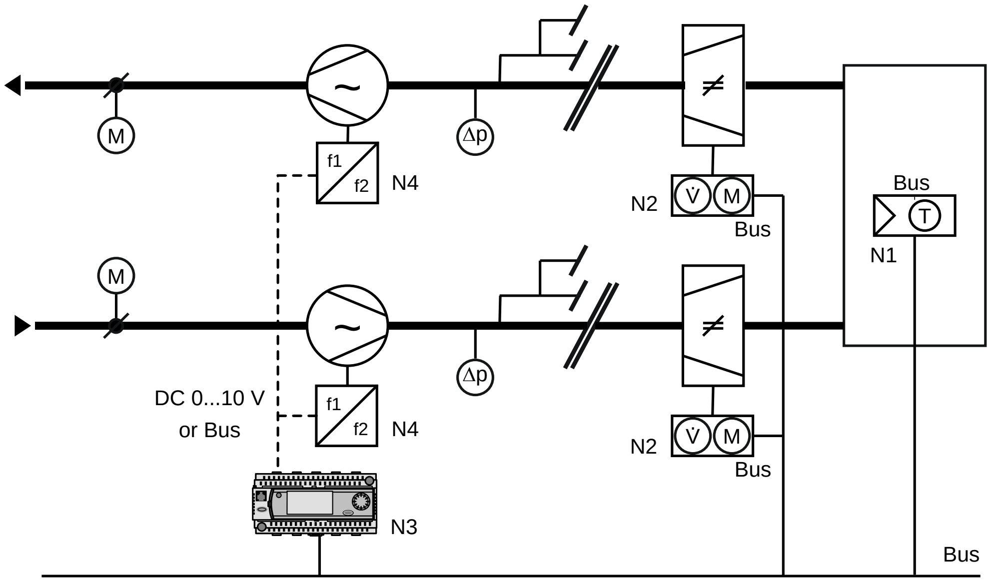
Bus	Fieldbus (Modbus, BACnet, KNX etc.)
N1	Room unit with temp. sensor
N2	VAV Compact Controllers (supply air / extract air)

3.2.2 Demand-controlled ventilation (DCV)

Example: AHU control optimization

In combination with a suitable supervisory room controller, an AHU control optimization algorithm can be run using the actual value of the damper position feedback signal.

The control of variable speed drives (VSDs) can be accomplished by various means. Below depicted is DC 0...10 V control, but plants with BACnet MS/TP- or Modbus RTU-controlled VSDs are also possible, depending on the connector layout of the universal / primary controller.



Legend:

Bus	Fieldbus (Modbus, BACnet, KNX etc.)
N1	Room unit with temp. sensor
N2	VAV Compact Controllers (supply / extract air)
N3	Universal / primary controller
N4	Variable Speed Drives (VSD)

4 Electrical and mechanical installation

4.1 Mechanical installation / mounting

Mounting and mounting limitations

For mounting and limitations on mounting (location / position), consulting the mounting instruction M3547 ([2]) is mandatory.

Environmental conditions

The permissible ambient temperature and ambient humidity must be observed.

Manual control

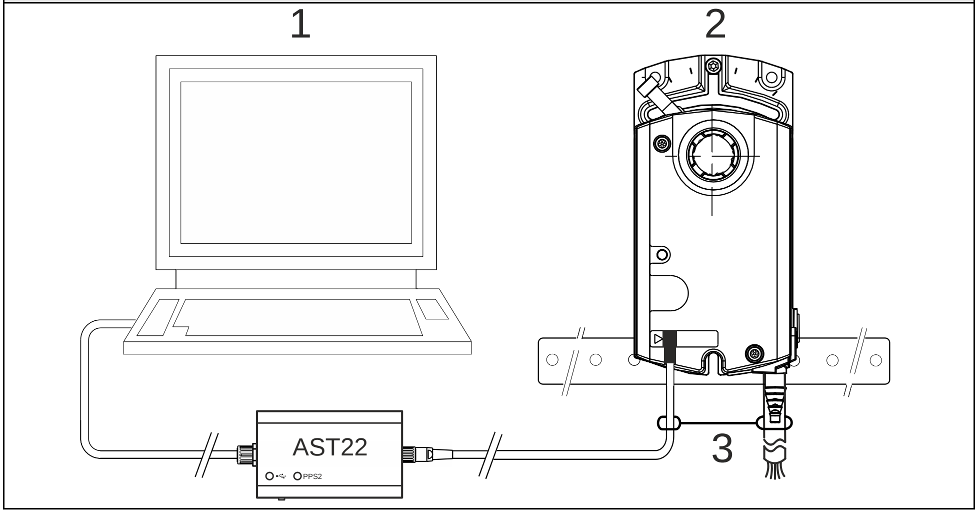
The actuator may only be manually operated when **separated from power supply**.

Mechanical limitation of angular rotation

If required, the angular rotation can be set by appropriate adjustment of the adjusting screw.

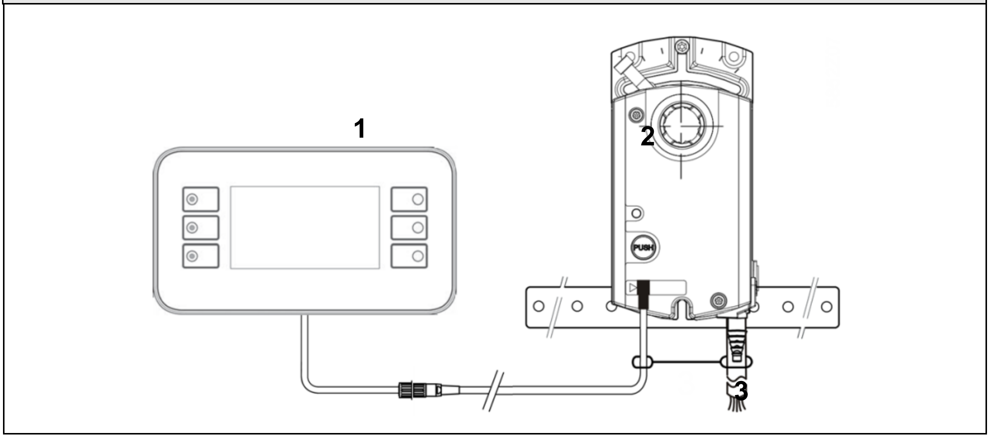
Configuration and maintenance interface

Connection of PC tool ACS931 / ACS941 to G..B181..



1 PC (with ACS931 or ACS941)
2 G..B181..
3 Strain release strip

Connection of handheld tool AST20 to G..B181..



1 AST20
2 G..B181..
3 Strain release strip

4.2 Electrical installation / cabling

4.2.1 Power supply cabling

Permissible cable lengths and cross-sectional areas

The permissible cable lengths and cross-sectional areas depend on the actuators' current draw and the voltage drop on the connecting lines to the actuators. The necessary cable lengths can be determined from the following chart or with the help of the formulas. Cf. also to technical data in section 8.

Note

When determining the cable length and the cross-sectional area, it is to ensure that the permissible tolerances of the actuators' operating voltage are adhered to, in addition to the permissible voltage drop on the power supply and signal lines (see table below).

Permissible voltage drop

The cables are to be sized depending on the type of actuator used and based on the following data:

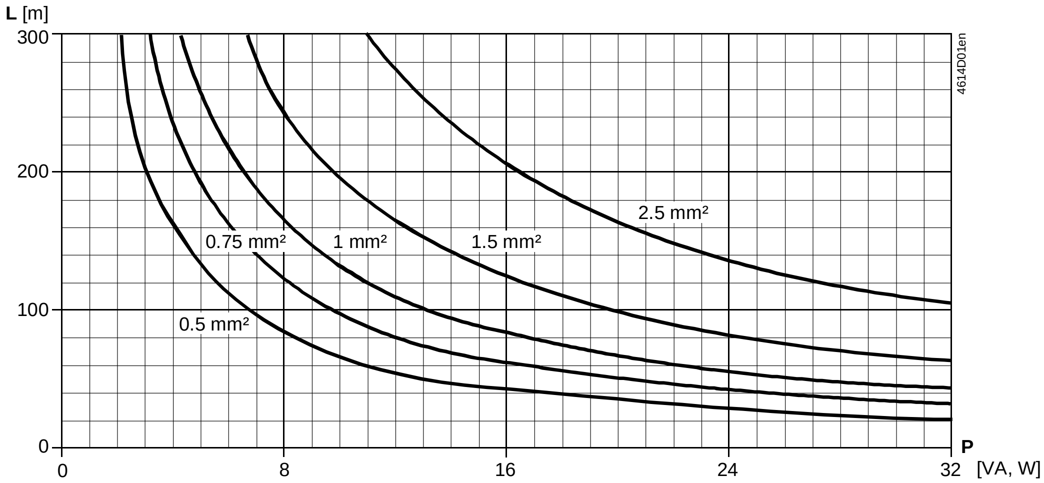
Type	Operating voltage	Line	Max. permissible voltage drop
GDB181 / GLB181	AC 24 V	G0, G	each 4 % (tot. 8 %)

Note

The power supply voltage drop at AC 24 V must not exceed 8 % (4 % over the G0).

L/P chart for AC 24 V

The chart below applies to AC 24 V operating voltage and shows the permissible cable length **L** as a function of power **P**, and the cross-sectional areas as a parameter.

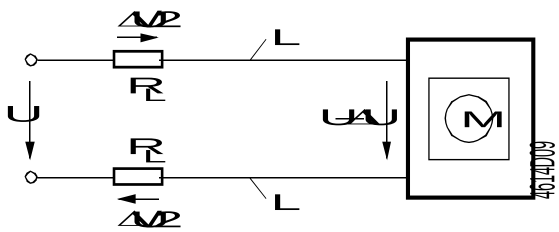


Note on chart

The values in [VA, W] on the P-abscissa are allocated to the permissible voltage drops (ΔU/2U = 4 %) on the line length L as per the above table and the basic diagram.

P is the decisive power consumption of all actuators connected in parallel.

Basic diagram: Voltage drop on the supply lines



Formula for cable length

The following formula can be used to calculate the maximum cable lengths.

Operating voltage	Permissible voltage drop per line	Formula for cable length
AC 24 V	4 % of AC 24 V	$L = \frac{1313 \bullet A}{P}$ [m]

A Cross-sectional area in [mm^2]
L Permissible cable length in [m]
P Power consumption in [VA] or [W]; refer to the actuator's type field

Example: Power consumption and permissible voltage drop (1 VAV controller)

Operating voltage	Power consumption	Perm. voltage drop for line... 1 (G), 2 (G0)
AC 24 V	3 VA	4 % of AC 24 V

Example: Parallel connection of 4 actuators

Determine the cable lengths for 4 actuators operating on AC 24 V. Decisive for sizing the cable are only the AC currents on lines 1 (G) and 2 (G0). Maximum permissible voltage drop = **4 % per line**.

- Consumption = 4 x 3 VA = 12 VA
- Line current = 4 x 0.125 A = 0.5 A

Permissible single cable length for G and G0:

- 164 m with a cross-sectional area of 1.5 mm^2
- 274 m with a cross-sectional area of 2.5 mm^2

4.2.2 Bus cabling

Instructions regarding topology and addressing in KNX networks can be found in [9]. The following sections presuppose electrical installations that conform to the KNX-TP1 standard

5 Parameterization and operating modes

5.1 Settings and user interaction

5.1.1 Device parameters

Parameterization

The OEM generally provides the basic configuration to VAV Compact Controllers, esp. the parameter V_n. The basic configuration is independent of the system environment where the VAV Compact Controllers are to be used.

For parameter setting, configuration and maintenance tools as described in section **0** are available. Depending on the networking environment (PL-Link, KNX LTE or KNX S-Mode), further settings are available (cf. chapter **9**).

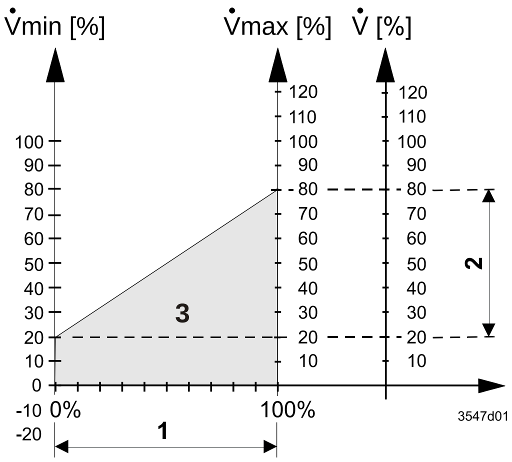
Parameter	Range	Description	Factory setting
Operating mode	VAV (flow ctrl.) / POS (position ctrl.)	Interpretation of setpoint VAV = Setpoint controls volume flow [%] POS = Setpoint controls damper position [%]	VAV
Opening direction	CW (R) / CCW (L)	Opening direction of air damper	CW (R)
Adaptive positioning	Off / On	Adaption of actual opening range to position feedback [1)] Off = mapping 0°...90° → 0…100 % On = mapping e.g. 0°...60° → 0...100 %	Off
Vmax	20…120%	Maximum air volume flow	100 %
Vmin	-20…100%	Minimum air volume flow	0 %
Vnom	0…60‘000 m^3/h	Nominal air volume flow [2)]	100 m^3/h
Vn	1.00…3.16	Characteristic value for the air volume flow; set by the manufacturer (OEM)	1.00
Altitude	0…5000m in 500m steps	Altitude level correction factor for differential pressure sensor (select n*500m value closest to real altitude)	500 meters

1) Adaptive positioning must not be activated while the actuator is mechanically jammed

2) Value used for displaying / not used for volume flow control loop

Variable air volume control (VAV)

VAV Compact Controllers operate in VAV mode when connected to the specified power supply. The setpoint signal determines the operating range $\dot{V}_{min} \dots \dot{V}_{max}$.



1 Setpoint
2 Actual value
3 Control range

Constant air volume control (CAV)

The VAV Compact Controllers can be operated in CAV mode by setting the setpoint value accordingly, i.e. setting the supervisory controller to send a constant setpoint.

Position control

VAV Compact Controllers can also be operated as damper actuators, i.e. the 0...100% setpoint is interpreted as position setpoint, cf. section **2.6**.

5.1.2 Calculation formulas

The parameters are based on the following formulas:

Calculation of Vn (Δpnom = nominal pressure)

$$V_n = \sqrt{\frac{300\ [Pa]}{\Delta p_{nom}[Pa]}}$$

300 Pa is the upper limit of the operating range of the differential pressure sensor. The nominal pressure is the differential pressure in the VAV box at a given nominal volume flow, determined by the OEM specification.

Min. and max. volume flows (Vmin / Vmax)

$$V_{min}[\%] = \frac{min.\ volume\ flow\ [m^3/h]}{nom.\ volume\ flow\ [m^3/h]} \cdot 100\%$$

$$V_{max}[\%] = \frac{max.\ volume\ flow\ [m^3/h]}{nom.\ volume\ flow\ [m^3/h]} \cdot 100\%$$

Actual relative flow as function of setpoint and min. / max. limits

$$FLW\ [\%] = \frac{Setpoint\ [\%] \cdot (V_{max} - V_{min})\ [\%]}{100\%} + V_{min}\ [\%]$$

Actual relative flow as function of differential pressure

$$FLW\ [\%] = 100\% \cdot V_n \cdot \sqrt{\frac{\Delta p[Pa]}{300[Pa]}}$$

Actual differential pressure as function of actual flow

$$\Delta p[Pa] = 300\ Pa \cdot \left(\frac{FLW[\%]}{100\% \cdot V_n}\right)^2$$

5.1.3 Conversion of C-values into Vn values

In case the C-value of a VAV box is known, it can be converted into a corresponding Vn value as both are linked by Δpnom.

Formulas are linked by Δpnom

$$\dot{V}_{nom} = C \cdot \sqrt{\Delta p_{nom}} \text{ and } V_n = \sqrt{\frac{300\ [Pa]}{\Delta p_{nom}[Pa]}} \rightarrow V_n = C \cdot \frac{\sqrt{300\ [Pa]}}{\dot{V}_{nom}}$$

Example for a box with C = 57.2 and Vnom = 900 m3/h:

$$V_n = C \cdot \frac{\sqrt{300\ [Pa]}}{\dot{V}_{nom}} = 57.2 \frac{[m^3/h]}{[\sqrt{Pa}]} \cdot \frac{\sqrt{300\ [Pa]}}{900\ [m^3/h]} = 1.1$$

In this case, set Vn = 1.1 which corresponds to a Δpnom = 248 Pa.

5.2 Configuration and maintenance tools

Configuration and retrieval of device parameters can be accomplished with the following tools:

- Using the PC software ACS941 or ACS931 together with the interface converter AST22 via the configuration and maintenance interface of the VAV Compact Controller or
- Using the handheld tool AST20.

5.2.1 PC software ACS941 and ACS931

Areas of use

The PC software versions ACS931 (for OEMs) and ACS941 (for service and maintenance staff) is used for setting and displaying the parameter values on a PC. Instructions for use of this software can be found in [5] and [6].

The PC software ACS941 allows to set or to display the parameters as listed in section **5.1**. The software supports trend functions and allows comparing the values set by the OEM with the values currently stored in the device. Thus, changes by parties other than the OEM can be detected.

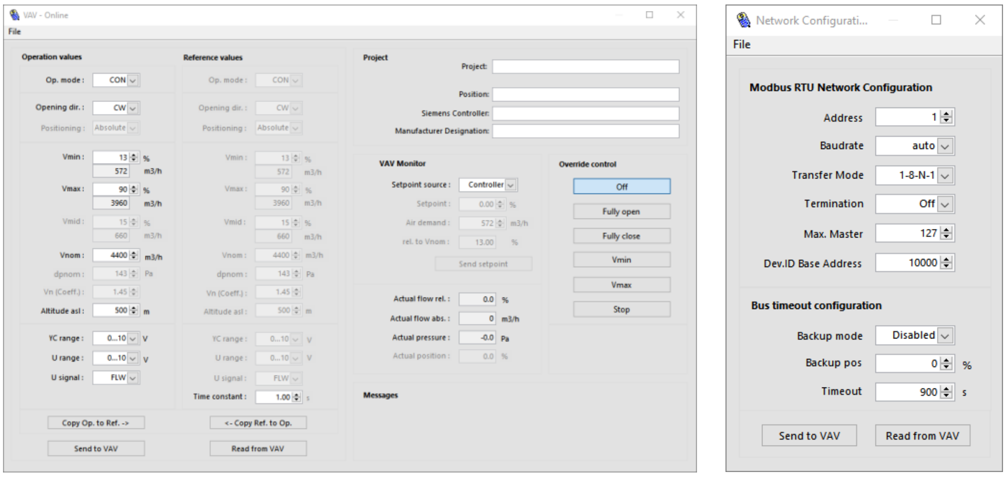


Figure 1: ACS941 with VAV (left) and network (right) configuration pane

Next to the PC software ACS941, an OEM version ACS931 with extended functionality is available as well. ACS931 allows setting the parameter V_n and changing the OEM default values. Its distribution is therefore restricted to OEM customers. For more details, see [5].

5.2.2 Handheld tool AST20

Functionality

Using the handheld tool AST20, VAV and actuator parameters can be set or retrieved, and device info and statistics can be read out. Instructions for use of the handheld tool AST20 can be found in data sheet [3].

Design

The AST20 is designed for portable use on-site. Power supply and establishing the communication between AST20 and a VAV Compact Controller are realized with one of the connection cables which are shipped with the AST20.

5.3 Setting examples

5.3.1 Symbols and parameters

Volume symbols with "point" ($\dot{V}$) and without point (V) shall have the same meaning, i.e., they all shall refer to volume flows.

Legend to the setting examples

$\dot{V}$	Volume flow [%]
$\dot{V}_{min}$	Minimum volume flow [%]
$\dot{V}_{max}$	Maximum volume flow [%]
$\dot{V}_{supply\_air}$	Volume flow of supply air controller [%]
$\dot{V}_{extract\_air}$	Volume flow of extract air controller [%]
$\dot{V}_{master}$	Volume flow of supply air controller (Master) [%]
$\dot{V}_{slave}$	Volume flow of extract air controller (Slave) [%]

5.3.2 Min/max control by the supervisory controller

When setting the minimum / maximum air volume flow in the supervisory controller, the VAV compact controller has to be configured with $\dot{V}_{min}$ = 0 % and $\dot{V}_{max}$ = 100 %.

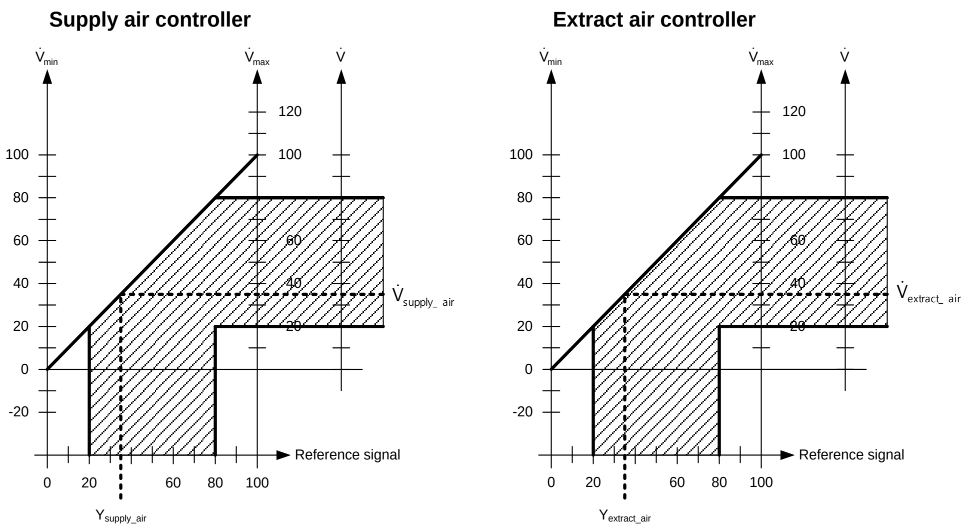
Setting example A1

VAV ratio control 1 : 1

	Supply air		**Extract air**	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	20 %	80 %	20 %	80 %
VAV compact controller	0 %	100 %	0 %	100 %

Reference signal: $Y_{supply\_air} = Y_{extract\_air} = 35$ %

Result: $V_{supply\_air} = V_{extract\_air} = 35$ %



Setting example A2

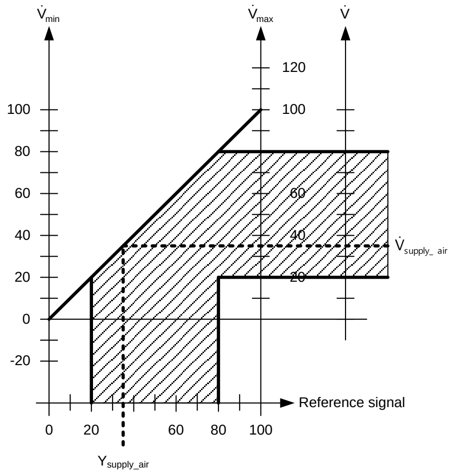
VAV ratio control, 20 % constant excess supply air volume flow (positive pressure in the room)

	Supply air		Extract air	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	**20 %**	**80 %**	**0 %**	**60 %**
VAV compact controller	0 %	100 %	0 %	100 %

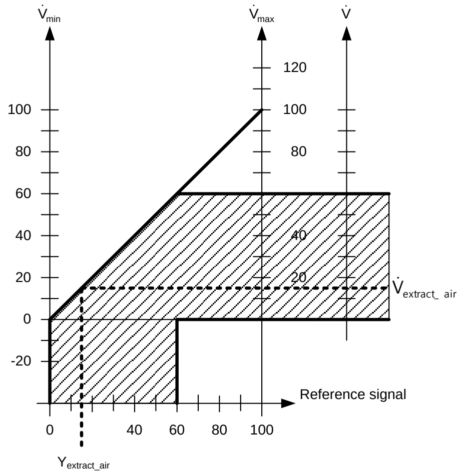
Reference signal: Y_{supply_air} = 35 %, $Y_{extract\_air}$ = Y_{supply_air} - 20 % = 15 %

Result: V_{supply_air} = 35 %, $V_{extract\_air}$ = 15 %

Supply air controller



Extract air controller



Setting example A3

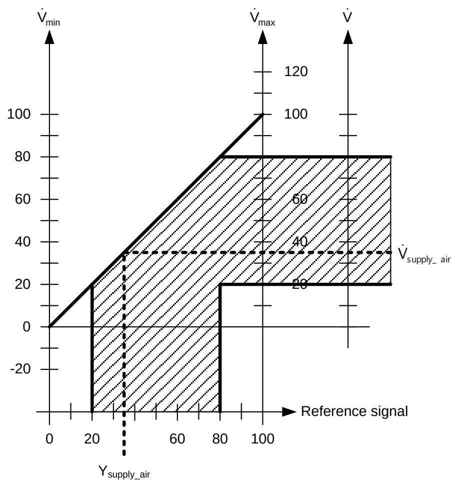
VAV ratio control, 20 % constant excess extract air volume flow (negative pressure in the room)

	Supply air		Extract air	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	**20 %**	**80 %**	**40 %**	**100 %**
VAV compact controller	0 %	100 %	0 %	100 %

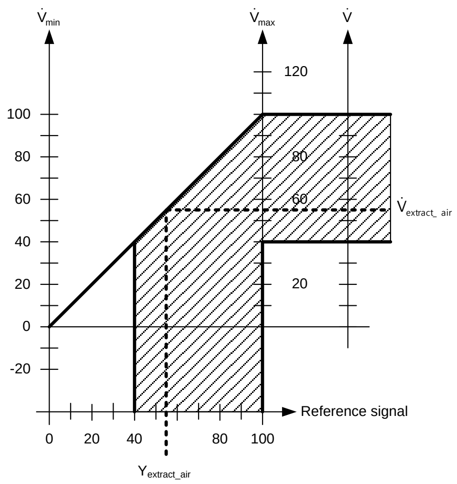
Reference signal: Y_{supply_air} = 35 %, $Y_{extract\_air}$ = Y_{supply_air} + 20 % = 55 %

Result: V_{supply_air} = 35 %, $V_{extract\_air}$ = 55 %

Supply air controller



Extract air controller



5.3.3 Min/max control by the VAV compact controller

When setting the minimum / maximum air volume flow in the VAV compact controller, the supervisory controller must be set to V_{min}= 0 % und V_{max} = 100 %. With this setting, the supervisory controller reference signal for both the supply air and extract air controller is the same. Thus, supply air / extract air control with a single reference signal is possible.

Setting example B1

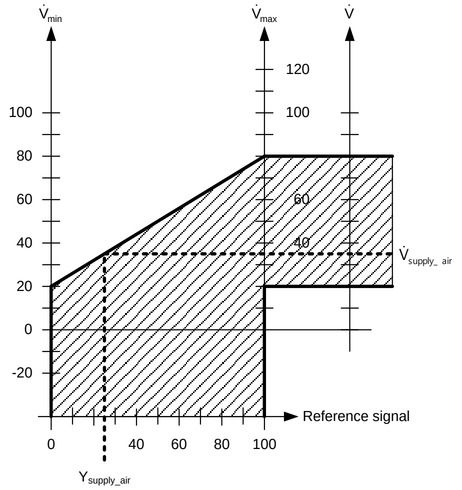
VAV ratio control 1 : 1

	Supply air		**Extract air**	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	0 %	100 %	0 %	100 %
VAV compact controller	**20 %**	**80 %**	**20 %**	**80 %**

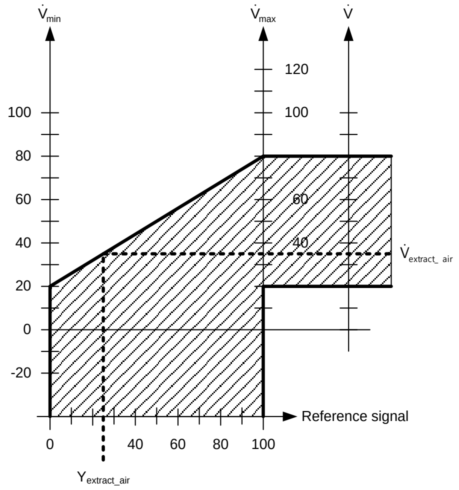
Reference signal: $Y_{supply\_air} = Y_{extract\_air} = 25$ %

Result: $V_{supply\_air} = V_{extract\_air} = 35$ %

Supply air controller



Extract air controller



Setting example B2

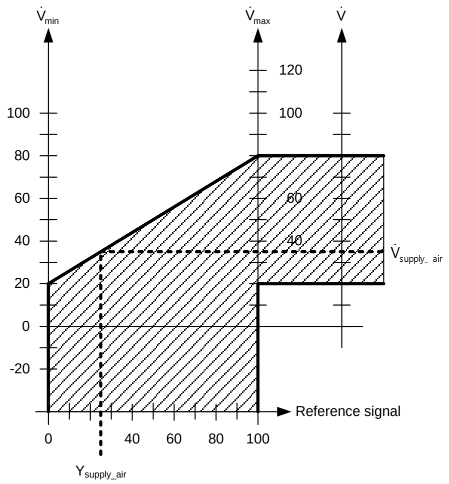
VAV ratio control, 20 % constant excess supply air volume flow (positive pressure in the room)

	Supply air		Extract air	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	0 %	100 %	0 %	100 %
VAV compact controller	**20 %**	**80 %**	**0 %**	**60 %**

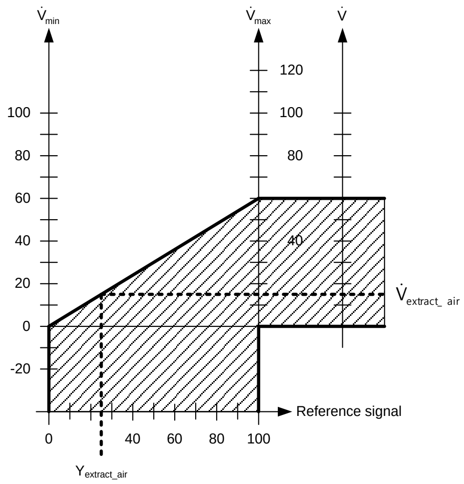
Reference signal: $Y_{supply\_air} = Y_{extract\_air} = 25$ %

Result: $V_{supply\_air} = 35$ %, $V_{extract\_air} = 15$ %

Supply air controller



Extract air controller



Setting example B3

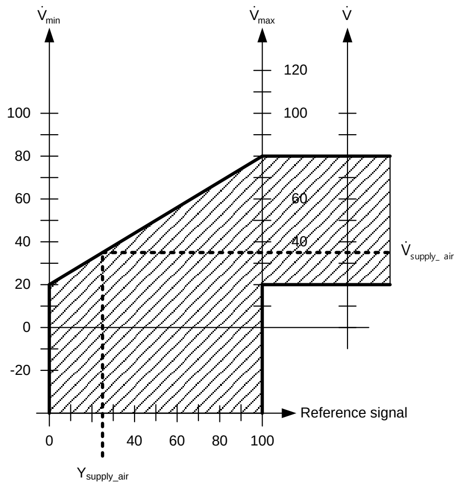
VAV ratio control, 20 % constant excess extract air volume flow (negative pressure in the room)

	Supply air		Extract air	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	0 %	100 %	0 %	100 %
VAV compact controller	**20 %**	**80 %**	**40 %**	**100 %**

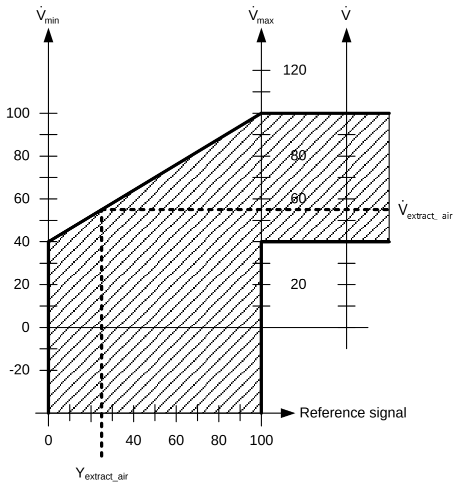
Reference signal: $Y_{supply\_air} = Y_{extract\_air} = 25$ %

Result: $V_{supply\_air} = 35$ %, $V_{supply\_air} = 55$ %

Supply air controller



Extract air controller



5.3.4 Master/Slave operating mode

To control supply air and extract air in KNX LTE-mode environments (Synco 700 Series C or newer), master/slave operating mode is required. In this mode, the actual value signal of the master controller (supply air) is the reference signal for the slave controller (extract air), cf. also section **6.2.2**.

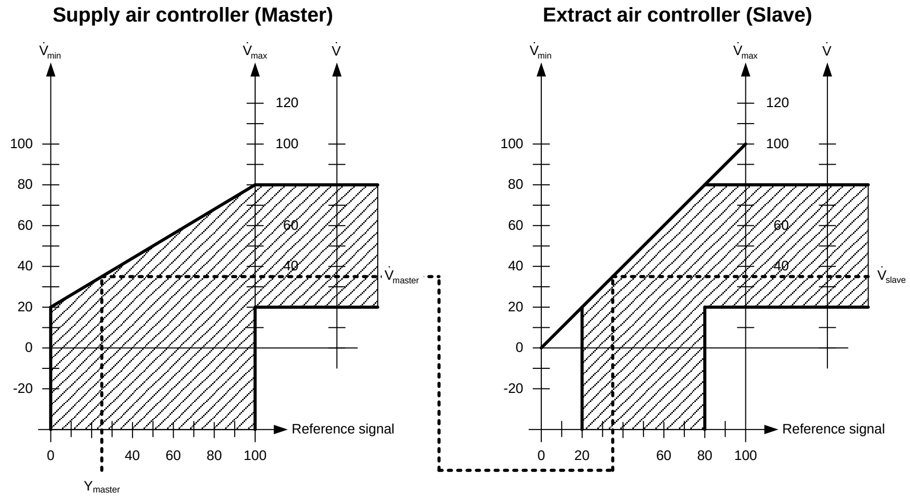
Setting example C1

VAV ratio control 1 : 1

	Supply air (Master)		**Extract air (Slave)**	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	0 %	100 %	0 %	100 %
VAV compact controller	**20 %**	**80 %**	**0 %**	**100 %**

Reference signal: Y_{master} = 25 %

Result: $V_{master} = V_{slave}$ = 35 %



Setting example C2

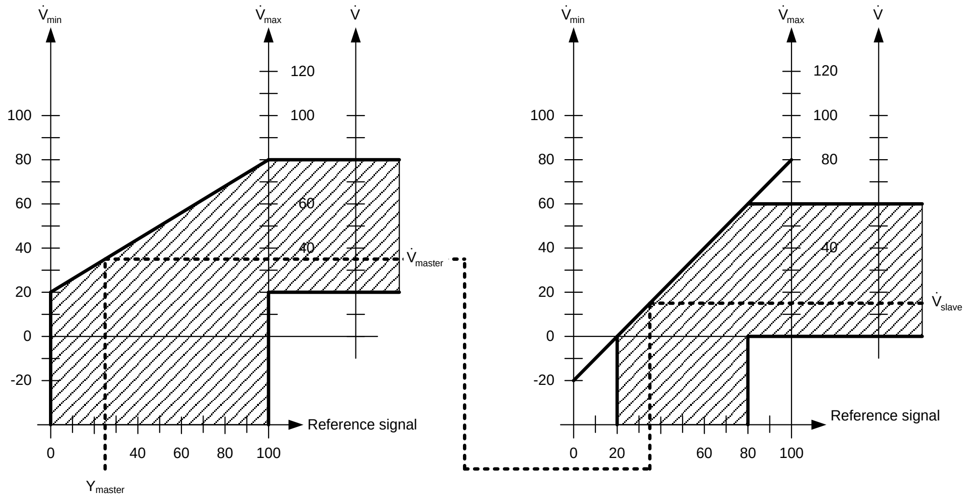
VAV ratio control, 20 % constant excess supply air volume flow (positive pressure in the room)

	Supply air (Master)		Extract air (Slave)	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	0 %	100 %	0 %	100 %
VAV compact controller	**20 %**	**80 %**	**-20 %**	**80 %**

Reference signal: Y_{master} = 25 %

Result: V_{master} = 35 %, V_{slave} = 15 %

Supply air controller (Master) **Extract air controller (Slave)**



Setting example C3

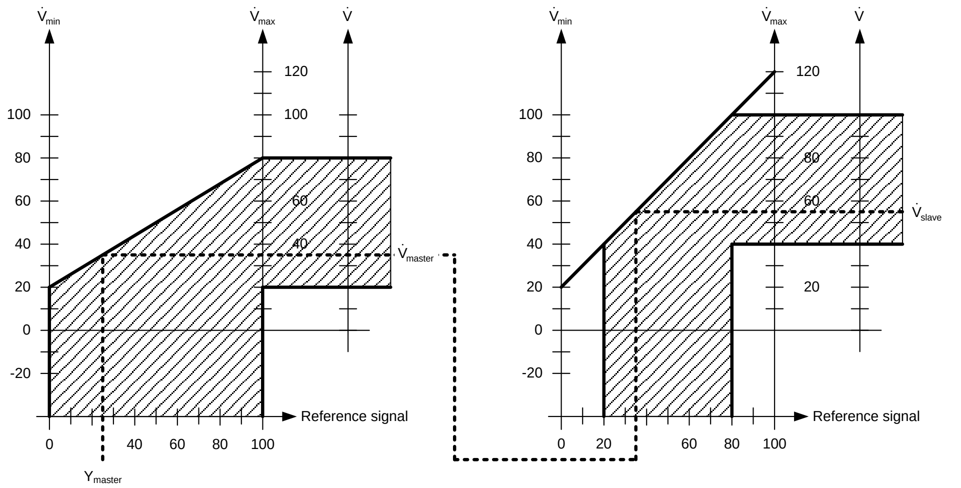
VAV ratio control, 20 % constant excess extract air volume flow (negative pressure in the room)

	Supply air (Master)		Extract air (Slave)	
	$\dot{V}_{min}$	$\dot{V}_{max}$	$\dot{V}_{min}$	$\dot{V}_{max}$
Supervisory controller	0 %	100 %	0 %	100 %
VAV compact controller	**20 %**	**80 %**	**20 %**	**120 %**

Reference signal: Y_{master} = 25 %

Result: V_{master} = 35 %, V_{slave} = 55 %

Supply air controller (Master) **Extract air controller (Slave)**



6 Engineering and commissioning

6.1 Fundamentals

6.1.1 System environments

Preconditions

For this chapter, sound knowledge about KNX networks and, depending on the systems environment, sufficient knowledge about the ETS software, ACS790 or Desigo ABT Site are presupposed.

Supported system / network environments and available engineering and commissioning tools are:

System environment	Engineering and commissioning tools	Further information
Desigo PL-Link	Desigo ABT, SSA	Online help
KNX LTE-mode	Synco ACS790	Technical basics P3127 Datasheet N3127
KNX S-mode	ETS4, ETS5	Documentation Y3110

- To connect a PC with USB interface to a KNX network, an interface converter (e.g. OCI700, contained in OCI700.1) is required.
- Other ways to connect to a network are IP interfaces, as made available by the PXC3.. automation station.
- The VAV compact controllers are delivered with the default KNX address 0.2.255
- Since the VAV compact controllers do have a separate AC 24 V power supply, their bus load is only 5 mA.
- Desigo PL-Link systems do not support the use of line couplers.

6.1.2 Documentation of engineering and commissioning

Use of planning and commissioning protocol recommended

It is highly recommended to document all planning data and settings in a way that is easily accessible after a long interval. Especially if special calculated parameters or plant-specific adaptations had to be made during engineering and commissioning, these should be clearly noted.

6.1.3 Address labels

The VAV compact controllers are delivered with a removable address label which contains the unique KNX ID in alphanumeric and barcode representation.

Facilitating engineering and commissioning

This label can be removed from the device during installation and attached to e.g. a building plan. The building plan, containing the device locations and their addresses (IDs) then facilitates further engineering and commissioning remarkably. This procedure is essential for the recommended engineering and commissioning workflows below. If the label gets lost, the ID is printed on the device housing as well.

6.2 Engineering

6.2.1 KNX S-mode engineering

Certified KNX product

The VAV compact controllers are certified KNX devices. For engineering and commissioning, the ETS software is used. The parameters and S-mode datapoints are documented in chapter Fehler! Verweisquelle konnte nicht gefunden werden..

Obtaining the KNX product data

The required product data (*.vd5 or *.knxprod) can be downloaded from the Siemens website and imported into the ETS device catalog. To obtain the product data, navigate to www.siemens.com/hvac-td or www.siemens.com/openair and locate the “Downloads” section.

6.2.2 KNX LTE-mode / Synco 700 engineering

Engineering in KNX LTE-mode environments (Synco 700) is performed with the tool ACS790 [8].

Recommendation: collect address labels during mounting

During mounting of the VAV compact controllers, the address labels can be removed from the devices and attached to e.g. the building/floor plan to map KNX-IDs and physical location of the devices.
After mounting and installation is completed, the installed devices are found when the ACS790 device list is refreshed. In the device list, the collected IDs can be used to identify the devices and to assign physical addresses according to the intended plant topology. With this approach, commissioning can be done without much effort. For an alternative commissioning procedure, cf. section **6.3.3**.

Special settings for Master/Slave configuration

Plants with supply air and extract air control in KNX LTE-mode environments with Synco 700 must be realized as a Master/Slave configuration (cf. section **5.3.4**). All devices have to be in the same air distribution zone which has to be set to “8” in Synco 700 systems.

The Slave-VAV compact controller’s air volume flow limits (V_{min} and V_{max}) have to be set to 0 % and 100 %. The VAV compact controllers have to be configured as Master and Slave in ACS790 (in “Plant engineering”, navigate to VAV compact controller / “Operation settings”).

The Master-VAV compact controller must be associated with “Supply air”, and the Slave-VAV compact controller must be associated with “Extract air”.

Parameter	RDG400KN	Supply air (Master)	Extract air (Slave)
Minimum and maximum volume flow	$V_{min} = x_1$ % $V_{max} = x_2$ % x_1, x_2 = Project values	$V_{min} = y_1$ % $V_{max} = y_2$ % y_1, y_2 = Project values	V_{min} = 0 % V_{max} = 100 %
Air distrib. zone	8	8	8
Master/Slave	-	Master	Slave
Type of air	-	Supply air	Extract air

6.2.3 Desigo PL-Link engineering

Engineering in Desigo PL-Link environments is accomplished with the Desigo ABT component ABT (Automated Building Tool). The webserver-based tool SSA (Setup and Service Assistant) is used for datapoint tests during commissioning.

Plug&play commissioning

To enable “plug&play” commissioning with Desigo PL-Link, the recommended engineering workflow has to be followed. At the core of this workflow is the preparation of the supervisory VAV-enabled automation station (e.g. PCX3..).

Recommended engineering workflow

The following (idealized) workflow is a recommendation to benefit from the features of the VAV compact controllers.

1. The **design engineer (DE)** plans the system using the engineering tool **Desigo XWP (ABT)**. Design data for an entire project is stored on an Engineering Data Server.
2. According to the plan, orders are released to OEMs and suppliers. **VAV box OEMs** order VAV compact controllers from the distribution center. The OEM manufactures the VAV boxes and adjusts the VAV compact controllers mainly by setting the parameter V_n (cf. section **2.6**). The preconfigured VAV boxes are then delivered to the construction or renovation site.
3. The **electrical installer (EI)** mounts the VAV boxes and removes the **address labels**. He attaches them to a building plan (or something comparable). This building plan is then forwarded to the DE.
4. The **DE** can now preconfigure the **automation station** (e.g. PXC3..) offline in **Desigo XWP (ABT)** as follows: After adding the required number of VAV compact controllers to an automation station, he can access the configuration panel of each VAV compact controller and enter the ID either by typing the alphanumeric code or – if supported – by scanning the barcode representation. This configuration is then compiled to a **pack&go file** for download into the physical automation station.
5. This pack&go file is forwarded to the **EI** who downloads it into the automation station. The EI or the **commissioning engineer (CE)** can do a first testing with the **SSA** tool.
6. The **CE** can use the design data and **Desigo XWP (ABT)** to complete the commissioning.

6.3 Commissioning

6.3.1 Preconditions

Commissioning requirements

Type and number of parameters that can be set may vary. Prior to commissioning, all VAV compact controllers must be mounted according to the mounting instruction M3547 as well as all other devices as per the corresponding mounting instructions. All devices must be connected to the power supply and bus cabling. Power supply and bus cabling must be tested.
For KNX installations with multiple lines, it is recommended to do the commissioning line by line.

Operating mode and display

After power-up, the device can assume the following states:

State / intended behavior	User action	Device response (LED)
Functionality available in all system environments		
Power-up / device starts up	Connect device to power supply	LED is *orange* / goes off after power-up is completed
Faultless operation	none	LED is off
Set device to programming / addressing mode	Short key press (<0.5 s)	LED is *red* (no time limit)
Reset device to factory settings	Long key press (>20 s)	LED flashes *orange* until reset is completed
Additional functionality available in PL-Link environments only		
Execute connection test	Middle key press (>2 s and <20 s)	LED flashes *orange* Then (each for 60 seconds or prior cancellation by key press): a) LED is green → connection test successful b) LED flashes *red* (1s – interval) → connection test *failed*
Acknowledge connection test	Short key press (<0.5 s)	LED is off

6.3.2 KNX S-mode commissioning

For KNX S-mode, the usual S-mode commissioning procedures with the ETS software apply. The HMI (push button and LED) conforms to the KNX standard. A short key press sets the device into programming mode (cf. section **2.4**).

6.3.3 KNX LTE-mode commissioning

VAV compact controllers, KNX LTE-mode controller and operating units are connected to the power supply. Refresh, and then open the **ACS790 device list**.

→ **variant 1 (with collected address labels)**

1. Select a VAV compact controller from the device list by ID (IDs are collected during mounting),
2. Double click the selected row to open the dialog box *"Address assignment"*,

or

→ **variant 2**

1. Set a VAV compact controller to addressing mode (Push button on device → LED shines red)
2. In ACS790, click button "Programming mode" → Address assignment → enter physical address → click "Write"

→ Enter a physical address and short description for the selected VAV compact controller,

→ Click *"Write"* to close dialog box,

→ Repeat steps for all VAV compact controllers for commissioning.

Continue: Further configuration with ACS790.

6.3.4 PL-Link commissioning

Multiple VAV compact controllers can be connected simultaneously to the power supply or individually. For plug&play commissioning, the PL-Link capable automation station must be preconfigured as described in section **6.2.3**.

The PL-Link automation station is online.
The VAV compact controllers are not connected to the power supply.

→ Simultaneously connect all VAV compact controllers to the power supply (or individually as applicable)

→ PL-Link automation station and VAV compact controllers execute registration and address assignment. Configuration is uploaded from the automation station to the VAV compact controllers.

→ Optional: Middle key press for connection test (>2 sec and <20 sec).

7 Safety and EMC optimization

7.1 Safety notes

STOP

This section contains general regulations and the regulations for mains and operating voltage. It also provides important information regarding your own safety and that of the entire plant.

Safety note

The warning triangle to the left means that observance of all relevant regulations and notes is mandatory. If ignored, injury to persons or damage to property may result.

General regulations

Observe the following regulations during engineering and project execution:

- Electrical and high-voltage directives of the respective country
- Other country-specific regulations
- House installation regulations of the respective country
- Regulations issued by the utility
- Diagrams, cable lists, disposition drawings, specifications and instructions as per the customer or the contractor in charge
- Third-party regulations issued by general contractors or building operators

Safety

The electrical safety of building automation and control systems supplied by Siemens depends primarily on the use of **extra low-voltage with safe isolation from mains voltage.**

SELV, PELV

Depending on the type of extra low-voltage earthing, a distinction is to be made between SELV and PELV as per HD 384, “Electrical plants in buildings“:
Unearthed = **SELV** (**S**afety **E**xtra **L**ow Voltage)
Earthed = **PELV** (**P**rotective **E**xtra **L**ow **V**oltage)

Earthing of G0 (system neutral)

Observe the following for grounding G0:
As a rule, earthing and non-earthing of G0 is permissible for AC 24 V operating voltage. Decisive are the local regulations and customary procedures. For functional reasons, earthing may be required or not permissible.

Recommendation on earthing G0

AC 24 V systems should always be earthed if this does not contradict the manufacturer’s specification.
To avoid earth loops, systems with **PELV may only be earthed at one point of the system,** normally by the transformer, unless otherwise specified.

Operating voltage AC 24 V

With regard to AC 24 V operating voltage, the following regulations must be complied with:

	Regulation
Operating voltage AC 24 V	The operating voltage must comply with the requirements for SELV or PELV: • Permissible deviation of AC 24 V nominal voltage at the actuators: +/–20 %
Specification on AC 24 V transformers	• Safety isolating transformers as per EN 61558, with double insulation, designed for 100 % on time to power SELV or PELV circuits • Determine the transformer's output by adding up the power consumption in VA of all actuators used • For efficiency reasons, the power drawn from the transformer should amount to at least 50 % of the nominal load • The transformer's nominal capacity must be at least 25 VA. With smaller transformers, the ratio of no-load voltage and full load voltage becomes unfavorable (> + 20 %)
Fusing of AC 24 V operating voltage	Secondary side of transformer: • According to the effective load of all connected devices • Line G (system potential) must always be fused • Where required, line G0 (system neutral) also

7.2 Device-specific regulations

⚠ Device safety

Among other aspects, the safety of devices is ensured by extra low-voltage power supply (AC 24 V) as per **SELV** or **PELV**.

Electrical parallel connection

Electrical parallel connection of VAV compact controllers is possible, provided the required operating voltage tolerance is observed. The **voltage drops of the supply lines** must be taken into consideration.

KNX bus powering

When planning and installing room controllers and field devices with KNX bus connection, the permissible cable lengths, power supply and topologies have to be followed. Planning should consider possible future extensions of a plant.

Note

Mechanical coupling of the devices is not permitted.

Warning, maintenance

Do not open the actuator!
The device is maintenance-free. Only the manufacturer may carry out any repair work.

7.3 Notes on EMC optimization

Running cable in a duct

Make sure to separate high-interference cables from equipment susceptible to interference.

Cable types

- Cable causing interference: Motor cables, especially motors used with VSDs, energy cables
- Cables susceptible to interference: Control cables, low-voltage cables, interface cables, LAN cables, digital and analog signal cables

Cable segregation

- You can run both types of cable in the same duct, but in different compartments
- If ducting with 3 closed sides and a partition is not available, separate the interference-emitting cables from other cables by a minimum of 150 mm, or route in separate ducting
- Cross high-interference cables with equipment susceptible to interference only at right angles
- If, in exceptional cases, signal and interference-emitting power cables are run in parallel, the risk of interference is high. In that case, limit the cable length of the DC 0...10 V positioning signal line for modulating actuators

Unshielded cables

In general, the use of unshielded cables is recommended. When selecting unshielded cables, the manufacturer's installation recommendations have to be followed. In general, **unshielded twisted pair cables** for building services plant (including data lines) offer adequate EMC characteristics, plus the advantage that no provision is required for coupling to earth.

8 Technical data

Power supply AC 24 V (SELV/PELV) G (core 1, red) and G0 (core 2, black)	Operating voltage / frequency	AC 24 V ±20 % or AC 24 V class 2 (US) / 50/60 Hz	
	Power consumption at		
	Actuator holds	1 VA/0.5 W	
	Actuator rotates	3 VA/2.5 W	
Damper actuator	Nominal torque	5 Nm (GDB) / 10 Nm (GLB)	
	Maximum torque	<7 Nm (GDB) / <14 Nm (GLB)	
	Nominal rotation angle / maximum rotation angle	90° / 95° ±2°	
	Running time for nominal rotation angle 90°	150 s (50 Hz) / 125 s (60 Hz)	
	Opening direction (adjustable with tool or over bus)	Clockwise / counter clockwise	
KNX-Bus	Connection type	KNX, TP1-256 (el. insulated)	
	Bus load	5 mA	
Configuration and maintenance interface	Terminal strip	7-pin, grid 2.00 mm	
Connection cable	Cable length	0.9 m	
	Number of cores and cross-sectional area	2 x 0,75 mm^2	
Degree of protection and safety class	Degree of protection acc. to EN 60529 (Refer to mounting instruction)	IP54	
	Safety class acc. to EN 60730	III	
Environmental conditions	Operation / transport	IEC 721-3-3 / IEC 721-3-2	
	Temperature	0...50 °C / –25…70 °C	
	Humidity (non-condensing)	<95 % r.h. / <95 % r.h.	
Standards and Regulations	Product safety		
	Automatic electric controls for household and similar use	EN 60730-2-14 (mode of action type 1)	
	Electromagnetic compatibility (Application)	For residential, commercial and industrial environments	
		GDB181.1E/KN	GLB181.1E/KN
	EU Conformity (CE)	A5W00003842 [1)]	A5W00000176 [1)]
		GDB181.1E/KN	GLB181.1E/KN
	RCM Conformity	A5W00003843 [1)]	A5W00000177 [1)]
Environmental compatibility	The product environmental declaration CM2E4634E [1)] contains data on environmentally compatible product design and assessments (RoHS compliance, materials composition, packaging, environmental benefit, disposal).		
Dimensions	W x H x D	71 x 158 x 61 mm	
Suitable drive shafts	Type of drive shaft		
	Round	8...16 mm	
	Round, with centering element	8...10 mm	
	Square	6...12.8 mm	
	Min. drive shaft length	30 mm	
	Max. shaft hardness	<300 HV	
Weight	Without packaging	0.6 kg	
Air volume controller	3-position controller with hysteresis		
	$\dot{V}_{max}$, adjustable (resolution 1 % / factory setting 100 %)	20…120 %	
	$\dot{V}_{min}$, adjustable (resolution 1 % / factory setting 0 %)	-20…100 %	
	$\dot{V}_{n}$, adjustable (resolution 0.01 / factory setting 1.00)	1…3,16	
	$\dot{V}_{n} = 1 \triangleq 300$ Pa at nominal air volume flow		
	$\dot{V}_{n} = 3{,}16 \triangleq 30$ Pa at nominal air volume flow		
Differential pressure sensor	Connection tubes (Interior diameter)	3…8 mm	
	Measuring range	0…500 Pa	
	Operating range	0…300 Pa	
	Precision at 23 °C, 966 mbar and optional mounting position		
	Zero point	± 0.2 Pa	
	Amplitude	± 4.5 % of the measured value	
	Drift	± 0.1 Pa / Year	
	Max. permissible operating pressure	3000 Pa	
	Max. permissible overload on one side	3000 Pa	

[1)] The documents can be downloaded from http://siemens.com/bt/download

9 Datapoints and function description

9.1 Device Parameters (ACS931 / ACS941 / AST20)

Parameter	Range	Description	Factory setting
Setpoint	0..100%	Setpoint to VAV controller. 0% → Vmin 100% → Vmax	N/A
Actual position	0..100%	Damper position, depends on setting for position adaptation	N/A
Actual Flow abs.	0..65'535 m^3/h	Actual volume flow in m^3/h or l/s	N/A
Actual Flow %	0..100%	Actual volume flow relative to Vnom in %	N/A
Actual pressure	0..300 Pa	Actual differential pressure	N/A
Override control	Open / Close / Stop / Min / Max	Override control from config. / maintenance tool	N/A
Operating mode	VAV / POS	VAV = Setpoint 0..100% volume flow POS = Setpoint 0..100% damper position	VAV
Opening direction	CW / CCW	Opening direction of air damper	CW
Positioning	Absolute / Adaptive	Adaption of actual opening range to position feedback [1)] Off = No adaptation / mapping 0°...90° → 0..100 % On = Pos. adaptation / mapping e.g. 0°...60° → 0..100 %	Absolute
Vmin	-20..100%	Minimum air volume flow	0 %
Vmax	20..120%	Maximum air volume flow	100 %
Vnom	0..65'535 m^3/h	Nominal air volume flow [2)]	100 m^3/h
Vn (Coefficient)	1..3.16	Characteristic value for the VAV box; set by the OEM	1.00
dpnom	30..300 Pa	Nominal differential pressure, corresponds to Vn	300 Pa
Altitude asl.	0..5000m, in 500m steps	Altitude level correction, select n*500m value closest to altitude of installation	500 meters
Unit vol. flow	m^3/h / l/s	Unit in which the volume flow is displayed	m^3/h
Unit Vmin & Vmax	%, m^3/h or l/s	Unit in which Vmin / Vmax are entered	%

[1)] Adaptive positioning must not be activated while the actuator is mechanically jammed

[2)] Value used for displaying / not used for volume flow control loop

Note

Some parameters are also available as ETS parameters. In this case, the ETS parameter setting overwrites the setting made with a configuration tool.

9.2 Engineering tool parameters

9.2.1 ETS Parameters

Parameter	Range	Description	Factory settings
Tab card "standard"			
Operating mode	VAV / POS	VAV: setpoint = volume flow 0…100% POS: setpoint = damper position 0…100%	VAV
Adaptive positioning	On / Off	Adaption of actual (if mech. limited) opening range to position feedback 0...100% Off = No adaptation / On = Pos. adaptation	Off
Altitude / Elevation asl.	0…5000m in 500m steps	Correction factor for diff. pressure sensor (select n*500m value closest to local altitude)	500 m
Backup timeout	0..60 min 0 min = disabled	Time interval to detect communication interruption. If disabled, the actuator drives to the last received setpoint until a new setpoint is received.	30 min.
Backup mode	Backup position Keep last position	Actuator behavior when the communication timeout has been exceeded (no setpoint received within the defined time interval). ▪ Backup position: Actuator drives to defined position ▪ Keep last position: Actuator keeps position without flow control	Backup position
Backup position	0…100%	Position the damper drives to in case of communication interruption	50%
Tab card "advanced"			
Hysteresis (COV)[1] volume flow	1...20%	Threshold for the relative volume flow. COV below this value are not sent over the bus.	1%
Min. repetition time volume flow	10...900 s	Minimum waiting time until a COV above the hysteresis threshold is sent over the bus	10 s
Hysteresis (COV) damper position	1...20%	Threshold for the damper position. COV below this value are not sent over the bus	1%
Min. repetition time damper position	10...900 s	Minimum waiting time until a COV above the hysteresis threshold is sent over the bus	10 s
Override position 1 [2]	0...100%	Damper position which can be triggered by the corresponding group object	0%
Override position 2 [2]	0…100%	Damper position which can be triggered by the corresponding group object	100%
Write Vnom	On / Off	If active, the group object for Vnom is writable (OEM parameter protection applies), otherwise it is read-only.	Off
Write Opening Direction	On / Off	If active, the group object for the opening direction is writable (OEM parameter protection applies), otherwise it is read-only.	Off

1) Adaptive positioning must not be activated while the actuator is mechanically jammed

2) Override position 1 has priority over Override position 2

9.2.2 Additional ACS790 Parameters

Parameter	Range	Description	Factory settings
Type of air	Outside air, Primary supply air, Supply air, Extract air	Type of air according to EN13779:2007	Outside air
Master/Slave	Autonomous, Master, Slave	Output signal of the supply air VAV controller is the reference signal for the extract air VAV controller.	Autonomous

9.3 S-mode group objects

9.3.1 Group objects list

Nr.	Name in ETS	Object function	Flags					Data point type KNX				Range
			C	R	W	T	U	ID	DPT_Name	Format	Unit	
1	Fault information	Transmit	1	1	0	1	0	219.001	_AlarmInfo	6 Byte	---	[0...255] = Log Nr. [0...2] = Alarm priority [0...14] = Application area [0...4] = Error class [0...7] = Attributes [0...7] = Alarm status
2	Fault state	Transmit	1	1	0	1	0	1.005	_Alarm	1 bit	---	0 = No alarm 1 = Alarm
3	Fault transmission	Receive	1	0	1	0	1	1.003	_Enable	1 bit	---	0 = Disable 1 = Enable
4	Setpoint	Receive	1	1	1	0	1	5.001	_Scaling	1 Byte	%	0...100%
5	Damper position	Transmit	1	1	0	1	0	5.001	_ Scaling	1 Byte	%	0...100%
6	Volume flow relative	Transmit	1	1	0	1	0	5.001	_ Scaling	1 Byte	%	0...100%
		Transmit	1	1	0	1	0	8.010	_Percent_V16	2 Bytes	%	-327.68...327.67%
		Transmit	1	1	0	1	0	5.004	_ Percent_U8	1 Byte	%	0…255%
7	Volume flow absolute [1)]	Transmit	1	1	0	1	0	9.009	_Value_Airflow	2 Bytes	m^3/h	-670 760...670 760 m3/h
		Transmit	1	1	0	1	0	14.077	_ Volume_Flux	4 Bytes	m^3/s	0...(2^{32} -1)
8	Fault	Transmit	1	1	0	1	0	1.005	_Alarm	1 bit	---	0 = No alarm 1 = Alarm
9	Overridden	Transmit	1	1	0	1	0	1.002	_Bool	1 bit	---	0 = False 1 = True
10	Override position 1	Receive	1	1	1	0	1	1.003	_Enable	1 bit	---	0 = Disable 1 = Enable
11	Override position 2	Receive	1	1	1	0	1	1.003	_Enable	1 bit	---	0 = Disable 1 = Enable
12	Balancing mode	Receive	1	1	1	0	0	1.003	_Enable	1 bit	---	0 = Disable 1 = Enable
13	Vmin	Receive	1	1	1	0	1	8.010	_Percent_V16	2 Bytes	%	-327.68...327.67%
14	Vmax	Receive	1	1	1	0	1	8.010	_Percent_V16	2 Bytes	%	-327.68…327.67%
15	Vnom	Read-only	1	1	0	0	0	9.009	_Value_Airflow	2 Bytes	m3/h	-670 760...670 760 m3/h
16	Opening direction	Read-only	1	1	0	0	0	1.012	_Invert	1 bit	---	0 = Not Inverted 1 = Inverted
17	Diff. pressure [2)]	Read-only	1	1	0	0	0	9.006	_Value_Pres	2 Bytes	Pa	0..670 760 Pa
		Read-only	1	1	0	0	0	14.058	_Value_Pressure	4 Bytes	Pa	0...(2^{32} -1)
18	Coefficient	Read-only	1	1	0	0	0	14.*	4-Byte Float	4 Bytes	---	0...3.16
19	OEM-Reset	Receive	1	0	1	0	0	1.017	_Trigger	1 bit	---	0, 1 = Trigger

[1)] For some group objects, alternative data point types (DPT) can be selected in ETS. The first entry indicates the default setting.

9.3.2 Group objects description

1 Fault information

If group object #3 ”fault transmission” is set to “on”, the following faults can be transmitted if they occur. In that case, group object #2 value changes to “alarm”.

Error	Group obj. #1 *	Description	Resolution
Device jammed	XX 00 0A 03 0C 05	Target position can’t be reached due to blockage.	Remove blockage (visual inspection required) or invert Opening direction, if it is set wrongly When done, switch on adaptive positioning if mechanical limits are intended.
Backup mode entered	XX 01 01 02 0C 05	Actuator is in backup mode (cf. respective parameter setting)	Actuator leaves Backup mode when receiving a setpoint.
Pressure sensor tubes inverted	XX 01 0A 01 0C 05	Pressure sensor measures the lower pressure on the input marked with “+”.	Correct the tubes connection
Pressure sensor malfunction	XX 01 0A 01 0C 05	Malfunction of internal communication to dp sensor (200 ms timeout)	1) Check tubes connection, or 2) reboot device, or 3) replace device
Operating hours notification	XX 01 0A 04 0C 05	Appears after a cumulated motor running time of 365 days	Check device status and control loop sensitivity

* “XX” designates a counter which starts at “00” and is incremented by 1 with each occurrence.

2 Fault state — Indicates whether the actuator is in fault state. If yes, read out group object #1.

3 Fault transmission — Enabling/ disabling the fault transmission. Fault transmission is disabled by default; therefore, no faults are transmitted from the actuator over the KNX bus.

4 Setpoint — Setpoint 0…100% for volume flow or position, depending on the operating mode.

5 Damper position — Relative damper position 0…100%. An opening range less than 0..90° can be normalized to 0..100% if adaptive positioning is set to “on”.

6 Volume flow relative — Volume flow relative to the settings of Vnom, Vmin, and Vmax.

7 Volume flow absolute — Volume flow in m^3/h or m^3/s depending on the selected data type.

8 Fault — Same function as group object #2 (available for compatibility reasons).

9 Overridden — Indicates whether the VAV compact controller is in override control either by a programming tool connected to the HMI or by objects #10 / #11.

10 Override position 1 — Drives the actuator to the override position 1 defined by the respective ETS parameter.

11 Override position 2 — Drives the actuator to the override position 2 defined by the respective ETS parameter.

12 Balancing mode — Drives the actuator to Vmax for air balancing purposes.

13 Vmin — Minimum air volume flow relative to Vnom.

14 Vmax — Maximum air volume flow relative to Vnom.

15 Vnom — Nominal air volume flow (absolute).

16 Opening direction — Opening direction of the air damper.

17 Diff. pressure — Actual value of the differential pressure over the VAV box measuring cross.

18 Coefficient — VAV box characteristic value to map a nominal differential pressure to the corresponding nominal volume flow.

19 OEM-Reset — Resets all parameters to the value specified by the OEM.

9.4 Alarms in LTE mode (ACS790)

The following alarms are available in ACS790.

Alarm ID	Alarm text	Description	What to do
0	No alarm		
5020	Communication error	Backup mode entered	• Check connection to room controller / thermostat • Resolved when new setpoint is received
90	Diff. pressure sensor error	Internal sensor error	• Check pressure tubes and nozzles for dirt • Restart device • Problem persists: Contact customer support
91	Diff. pressure sensor tubes interchanged	Tubes interchanged at P+ and P-	• Change tubes connection
1921	Expected operating hours	Appears after a cumulated motor running time of 365 days	• Check device status and control loop sensitivity • Problem persists: Contact customer support

9.5 Parameter and function description

9.5.1 Vnom (nominal volume flow) [m^3/h or l/s]

VAV boxes are ordered through an OEM according to this nominal volume flow and min. / max. volume flow settings. The maximum volume flow for ventilating a room / zone can't be higher than the nominal volume flow. Often the maximum volume flow is lower than Vnom for potential future expansions of volume flows.

9.5.2 Vmin / Vmax (minimum / maximum volume flow) [%]

These values limit the nominal volume flow by multiplying with Vnom. Their effect is described in chapter **5.**

9.5.3 Elevation above sea level [m]

This value enhances the accuracy of the differential pressure sensor to compensate for the air density decreasing with increasing altitude. It can be set in 500m steps, so for a given building the setting closest to the actual altitude is to be used.

Example: Altitude of building: 420m a.s.l. → use setting "500m"

9.5.4 Override control

The actuator can be operated in override control for checking / maintenance purposes or system-wide functions (e.g. night-cooling).

9.5.4.1 Local override:

The actuator enters this state when a service tool is connected at the service interface (PPS2).

- Open / Close (depends on opening direction)
- Stop
- If the actuator is in backup mode, it will be controllable in local override but resume the backup mode
  - when the service tool is disconnected,
  - when the local override timeout is exceeded, or
  - when the override control is set to "off".
- Timeout is 10s after the last read or write access.

9.5.4.2 Remote override:

The actuator enters this state when an override command is sent over the bus. The override control is available as KNX group object "Override position 1/2" with associated position parameters. When the group object is set to "enable" over KNX, the actuator drives to the associated position with override priority. It needs to be actively reset to "disable" to turn off override control.

9.5.5 Adaptive positioning

9.5.5.1 Function

For VAV boxes and air dampers with an opening range smaller than 0...90°, the position setpoint and feedback signal can be adapted to 0...100%.

- Adaptive positioning **off**: Position control / feedback relative to 0°…90°,
  →Example: 0° → 0%, 18° → 20%, 81° → 90% etc.

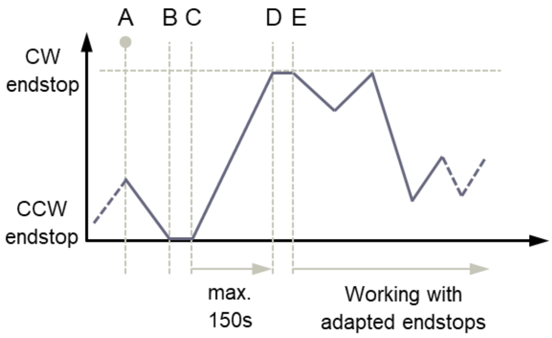
- Adaptive positioning **on**: Position control / feedback relative to the *mechanical* lower / upper endstops which are determined in an adaptation run.
  →Example: The lower endstop is at 15° and the upper endstop is at 60°
  15° → 0%, 45° → 66%, 60° → 100% etc.

9.5.5.2 Activation and deactivation

- Immediately after changing the parameter “Adaptive positioning” from **off** to **on**, an adaptation run is performed. During the adaptation run, the actuator drives to both mechanical end stops and stores these positions persistently as 0% and 100% reference points. Cf. diagram below for a detailed description.

Important: Adaptation must not be activated while a device jam is present!

- Adaptive positioning can be (de-)activated with the service interface (ACS931 / ACS941 / AST20) or over the bus.
- If adaptive positioning is deactivated *before the adaptation run has finished*, the adaptation run will stop immediately, and no end stops will be stored.
- In case of a power reset during the adaptation run, the adaptation run will restart automatically after the power supply has been restored.
- To trigger the adaptation run again the adaptive positioning must be turned off and on again.
- A manual gear disengagement of less than 20 seconds doesn’t impact the adaptation run or its result.



A. Adaptive positioning is set to on. Actuator drives to the counter-clockwise (CCW) endstop.
B. CCW endstop is reached.
C. If the position remains constant for ca. 10 seconds, it is stored non-volatile. The actuator then drives to the clockwise (CW) endstop.
D. CW endstop is reached.
E. If the position remains constant for ca. 10 seconds, it is stored non-volatile. The actuator now follows the adapted setpoint.

Example: Stop screw set at ~75% of the full range

Note: If the adaptation run starts close to the CW endstop, it can take up to 5.5 minutes for completion (2x 150s + waiting times in the endstops).

9.5.6 Device Jam

- If an actuator can't reach a target position due to a mechanical failure or an angle limitation screw, a device jam alarm is thrown as ETS error, see "Group objects description".
- The device jam is detected ca. 30s after the effective mechanical end stop (when lying before the target end stop) is reached.
- After 30..35s the motor stops and an alarm/status message is sent over the bus if configured accordingly.
- Initiating an adaptation run while the actuator is jammed does not resolve the alarm by using the mechanical end stop as reference position.

9.5.7 Operating mode

The operating mode determines whether the setpoint signal (0…100 %) from the supervisory controller is interpreted as volume flow control or as (air damper) position control.

If used as damper control signal, the actual values from the flow sensor remain available. This allows to implement the flow control loop in an external controller.

9.5.8 Backup mode

In case the communication to the controller is lost, the device can be configured to go into a defined state. This function utilizes a watchdog which monitors setpoint write access over the bus.

Default setting of this backup mode is "Off", i.e. in case of a communication loss, the device controls to the last received setpoint until an updated setpoint is received.

If the backup mode is enabled, it can be configured as follows:

- go to a position predefined by the parameter "Backup position",
- keep current position without controlling to the last received setpoint.

When the device is in backup mode and receives a setpoint over the bus again, it wakes up and controls to the setpoint again.

9.5.9 Restarting the device

Restarting is possible by a power-reset (switching operating voltage off and on). Effect of restart: Device re-initializes and sets all process values to defaults. Parameters and group object bindings are not reset.

9.5.10 Reset behavior

The actuator supports the following re-initialization / reset behavior:

- Local reset by push-button: cf. section **2.4**
- Tool-reset, cf. section **0**
- Remote reset: Using the "OEM Reset" group object.

Effect of reset:

- Process values: set to ex-works default values.
- Parameters:
  - Application and actuator parameters are set to factory or OEM defaults,
  - Network parameters are reset only in case of local reset, not by remote reset (otherwise loss of communication).
- Counters, status flags, and factory data are not reset.

9.6 Communication object priorities

The communication objects are prioritized as listed in the table below. An override signal is active until it is disabled or the HMI/tool is disconnected from the VAV compact controller. The backup gets disabled when a new setpoint is received or a power reset is done.

Prio	State	Behavior after power reset
1	Manual gear disengagement	Independent
2	Adaptation run	Will be restarted all over
3	Local override control	Will be reset
4	Remote override position 1	Will be reset
5	Balancing mode	Will be reset [1)]
6	Remote override position 2	Will be reset
7	Setpoint	Will be reset
8	Backup mode	Will be reset

[1)] Only effective in VAV mode.

10 Environmental compatibility and disposal

General notes

The products were developed and manufactured by using environmentally compatible materials and by complying with environmental standards.
For disposal, please remember the following at the end of product life or in case of defects:

- The products consist of plastics and materials such as steel, ferrite magnetic core, etc. and must not be disposed of together with domestic waste; this applies particularly to the printed circuit boards.

  See also European Directive 2012/19/EU
- As a rule, dispose of all waste in an environmentally compatible manner and in accordance with the latest developments in environmental, recycling and disposal techniques.
  Local and currently valid legislation must be observed.
- The aim is to achieve maximum recyclability of the basic materials while ensuring minimum strain on the environment. To do this, note the various material and disposal notes printed on specific components

Environmental declaration

The Environmental Declarations on these products contain detailed information about the materials and volumes used. If you need a copy, please contact your Siemens sales office.

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